Space Weather Technical Forecast

Issued on Saturday, 27 May 2023 at 01:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1/R2 radio blackouts. Active high energy electron fluence.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Moderate, with one M1.2 flare at 26/2303UTC from AR3315. This region continues to slowly evolve and contains a weak delta spot. AR3314 also appears to be developing with the positive and negative penumbra close to combining. A C5.5 flare from this region at 26/1741UTC appears to a generated a CME which will be analysed when sufficient imagery becomes available. The remaining regions are either weak, stable or fading. A further CME observed leaving the south of the Sun on coronagraph imagery late on 26 May will be assessed once sufficient satellite imagery becomes available.

Solar Wind / Geomagnetic Activity: Solar winds observed at L1 showed the solar wind easing from 500km/s to 425km/s, as the influence of coronal hole 06 weakens. Density is currently around or below average. Total interplanetary magnetic field strength is weak, with the north-south component also varying weakly. Phi angle was negative (towards the Sun) throughout. Geomagnetic activity was Quiet throughout.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV at GOES-16) has remained at background levels throughout. High energy electron flux (greater than 2MeV at GOES-16), was mainly High, with a brief spells of Moderate from 26/0200-0615 UTC. Peak flux was 4080 pfu at 26/1510 UTC. The associated 24 hour fluence was Active (above 1e8 integrated pfu) with a rising trend, reaching 1.99e8 integrated pfu at 26/0000UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Low to Moderate solar activity, forecast, mainly due to the configuration and development of AR3315, but with an increasing risk from AR3314 in the northwest quadrant.

Solar Wind / Geomagnetic Activity: A weak CME which left the Sun on 22 May may glance the Earth during 27 May, but with low confidence. A further CME which left the Sun on 25 May may arrive at Earth either 29 or 30 May, but again confidence is low. Otherwise the high speed stream from coronal hole 06 is expected to ease through 27 and 28 May, with the high speed stream from coronal hole 07 then expected to connect on 29 or 30 May and could coincide with the possible CME arrival. Mainly Quiet with some Unsettled intervals possible throughout the period. Possible Active or G1/Minor Storms on 27 May due to the potential glancing CME. A further chance of G1/Minor Storms on 29 or 30 May.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels. High energy electron flux (greater than 2MeV) is expected to oscillate through moderate to high levels during the period, with increasingly high diurnal peaks. The forecast CME arrivals and high speed stream connections could generate enough geomagnetic activity to disrupt this cycle, but with limited confidence. Electron fluence values are expected to remain above the Active (1e8 integrated pfu) threshold, but with decreasing confidence later in the period.

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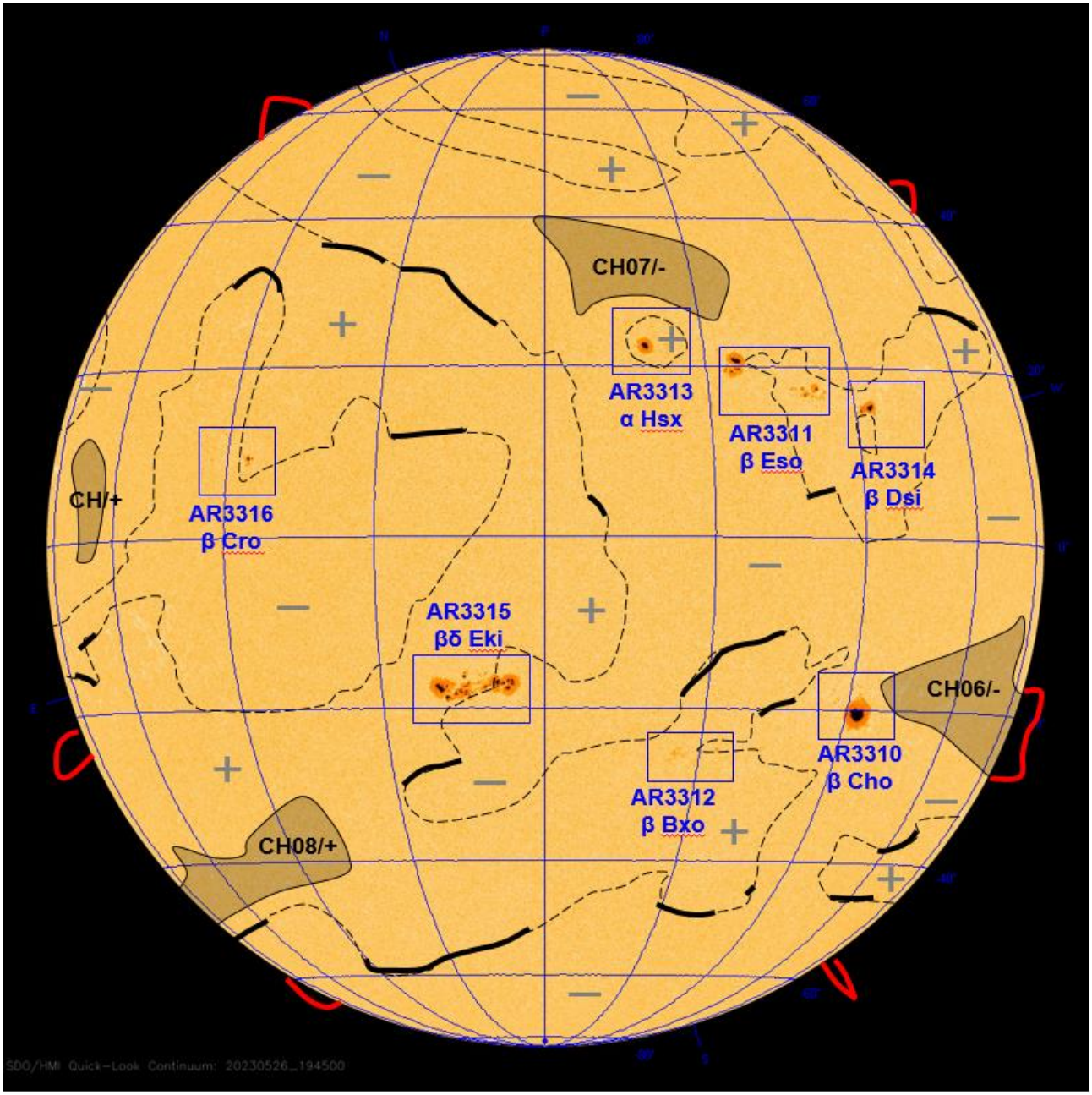
Figure 1. Solar Analysis Valid 26/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are two CMEs in the forecast. The first, which originated from the southeast of the Sun on is forecast to be missing Earth, with a possible glancing blow on 27 May. The second potential Earth-directed CME left the Sun on 25 May and is forecast to arrive at Earth on 29 or 30 May, but with low confidence. No further possible earth-directed CMEs have been identified. Otherwise Earth is under the influence of slightly elevated winds from the high speed stream of coronal hole 06 which is expected to continue to decline through the period. The high speed stream from coronal hole 07 is then forecast to connect with Earth. Connection is forecast for either 28 or 29 May based on an estimated speed of 500km/s.

Mainly Quiet geomagnetic activity is forecast throughout the period, with isolated Unsettled intervals. There is a slight chance of Active or G1/Minor Storm intervals either on 27 May due to the possible CME arrival, or on 29 May due to a possible combination of high speed stream connection and CME arrival.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
22/2313	Partial	AR3312	SE	353 km/s	Possibly around 27/0000UTC	Small chance of a glance
26/0144	Partial	AR3312	S	347 km/s	30/2200 +/- 9 hours	Weak glancing impact

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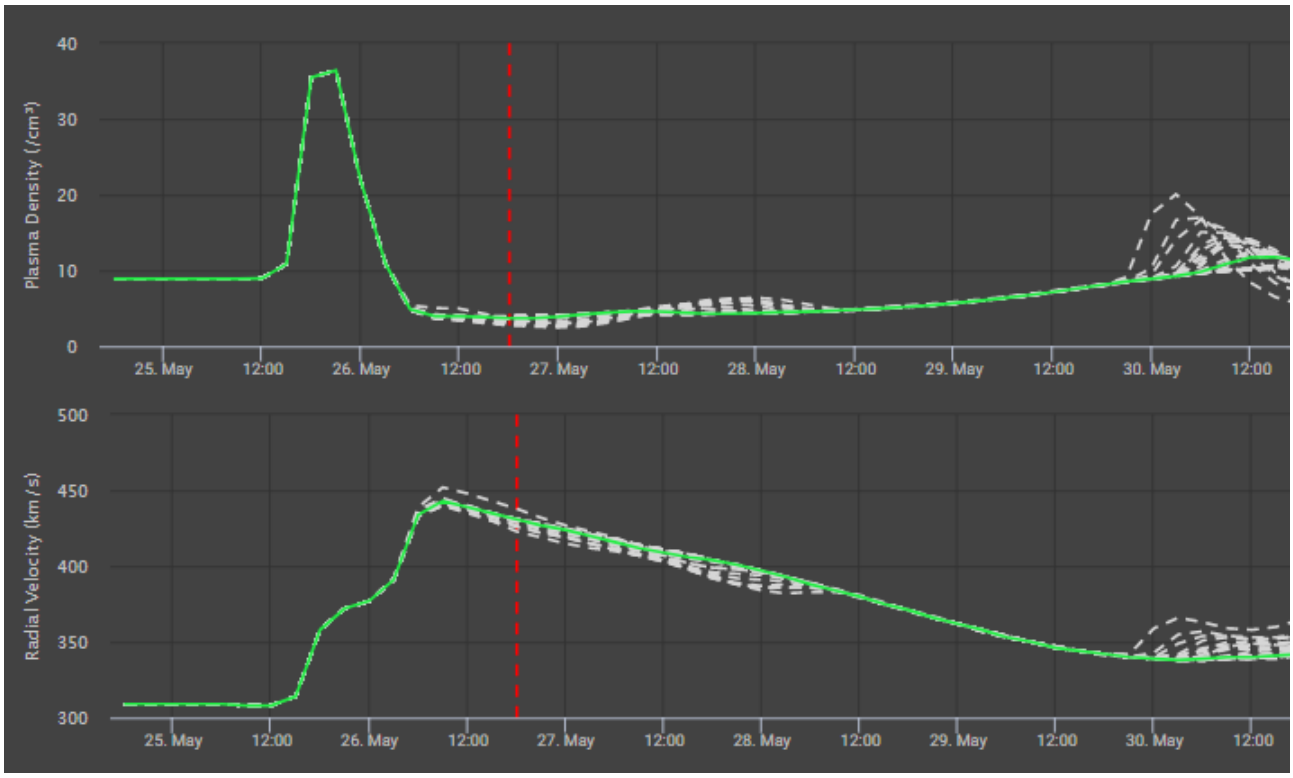
Figure 2: Enlil ensemble output showing timing of possible CME impacts



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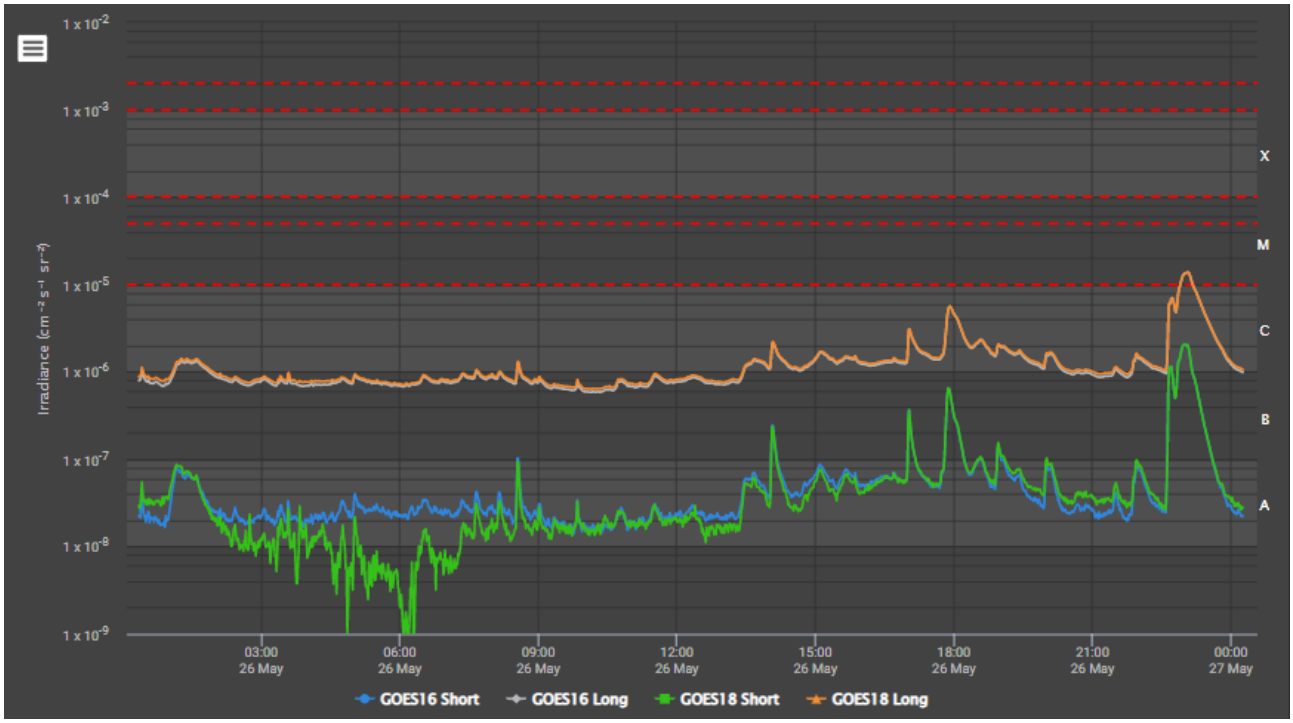
Radio Blackouts - X-Ray Flares:
Moderate to Low activity is forecast through the period, with a slight chance of X-class flares.

AR3315 is the most prominent and active region, with consistent albeit slow development and a persistent central delta region. AR3314 has developed, with the penumbra of the positive and negative regions close to merging, so will need to be monitored. This is the western end of a string of regions in the northwest with AR3313 and AR3311 both either simple or simplifying. AR3312 in the southwest continues to weaken, with AR3310 also losing a number of spots to the north. AR3316 in the northeast appears weak and stable.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	60	60	60
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES 16 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux, as observed by GOES16, is at background levels and is currently expected to remain so throughout the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is oscillating between high and moderate levels, with diurnal peaks gradually increasing. This pattern is likely to continue through the period in the absence of any strong high speed streams or significant geomagnetic activity. The most likely source for any notable reduction is from the possible connection to the high speed stream from coronal hole 07, which is likely on 29 May.

Associated 24 hour fluence is expected to be above the Active threshold throughout, but with a slight decrease in probabilities on 29 and 30 May due to the risk of the onset of the high speed stream and also the natural electron decay from the radiation belts.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	80	80	80
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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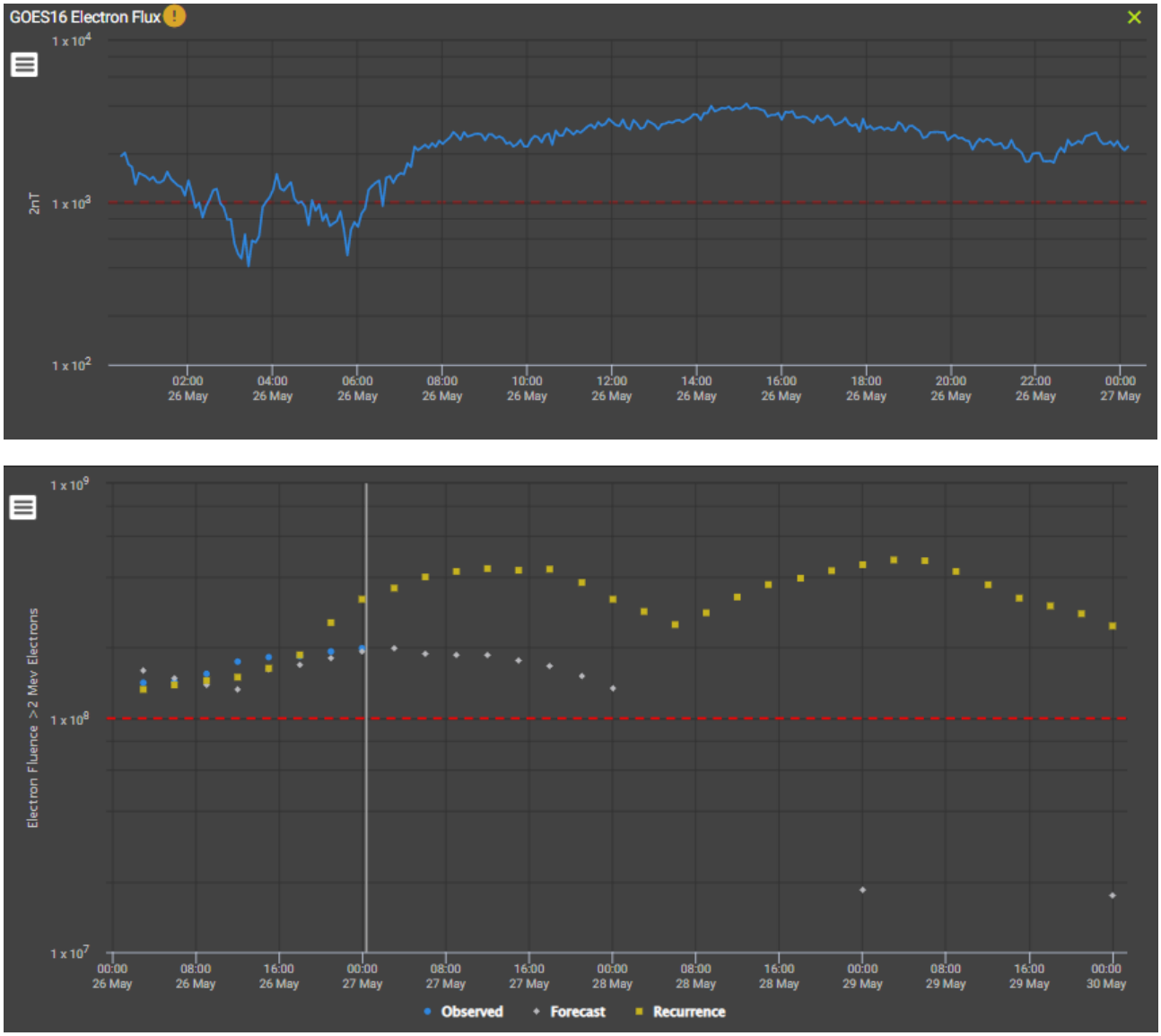
Figure 4: GOES-16 electron flux and MOSWOC REFM fluence forecast. Currently the forecast is indicating a fall below the threshold on 28 May, which is well below forecast expectations.



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